WS101-15: Multicolor Thomson X-ray sources

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Thomson backscattering X-ray sources are a promising way of generating high-brilliance X-ray pulses. Using a laser-wakefield-accelerated (LWFA-), ultrashort, ultrahigh-current relativistic electron bunches as a scattering medium for the laser field, such a source could potentially made very compact and would afford a high degree of control over the X-ray parameters. The shock-front injection approach to LWFA yields narrowband electron bunches with adjustable energy and multi-kA peak currents in a mm-scale accelerator, which exhibit emittance parameters close to the best conventional accelerators. This makes such bunches a ideal scattering target. We show that by controlling the electron energy, we can tune the X-ray energy over a wide range of parameters[1]. Likewise, by moving the scattering point along the axis of an LWFA, we can choose the scattering energy regardless of the final electron energy, giving an even greater range of freedom. We also show that X-rays from such a backscatter source can be used for imaging and that their penetration through different materials scales with energy.

By producing two independently tuneable electron bunches from a single laser shot, we demonstrate how a dual-color X-ray source with variable pulse delay could be constructed[2]. Finally, we will show how we can further improve the source brilliance by tailoring the scattering laser pulse to yield as narrowband pulses as possible with a given electron spectrum.

[1] Khrennikov, *et al.*, Tunable All-Optical Quasimonochromatic Thomson-Ray Source in the Nonlinear Regime, Phys. Rev. Lett. **114**, (2015), 195003.

[2] Wenz et al., Dual-energy electron beams from a compact laser-driven accelerator, Nat. Photon., (2019) DOI: https://doi.org/10.1038/s41566-019-0356-z

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